Implications Of Increasing Man Made Noise Floor Levels On Radio Broadcasting

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Noise is Everywhere

- Noise has been a fact of life since Marconi first complained about ignition noise from early cars.
- With the state of the art of receivers, the ambient noise floor, rather than the receiver sensitivity determines the receiving threshold in the AM & FM bands.
- There are three basic types of radio noise: Natural, Unintentional, and Intentional.

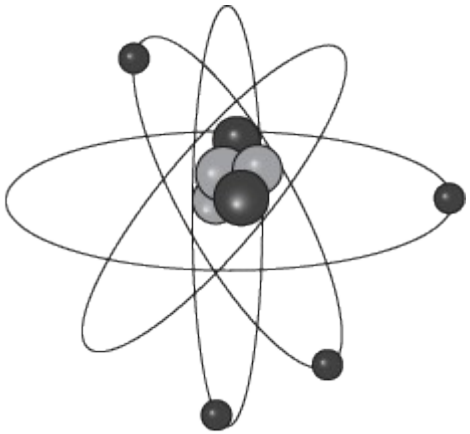
Natural Noise: Atmospheric

- Atmospheric Noise: Atmospheric noise is primarily caused by lightning, and as such, varies due to the proximity to storms, and the time of the year. The noise amplitude caused declines roughly 50 dB per frequency decade from 10 kHz to 10 MHz.

- Atmospheric noise is the dominant natural noise source in the AM band. Atmospheric noise is more problematic in the night time hours because distant lightning storms can propagate long distances via sky wave.

Natural Noise: Thermal

- Thermal Noise: Also known as Johnson–Nyquist noise. Caused by thermal agitation of electrons, and is roughly linear with respect to frequency.



- Because atmospheric noise declines so dramatically with frequency, thermal noise is the dominant natural noise source on the FM broadcast band.

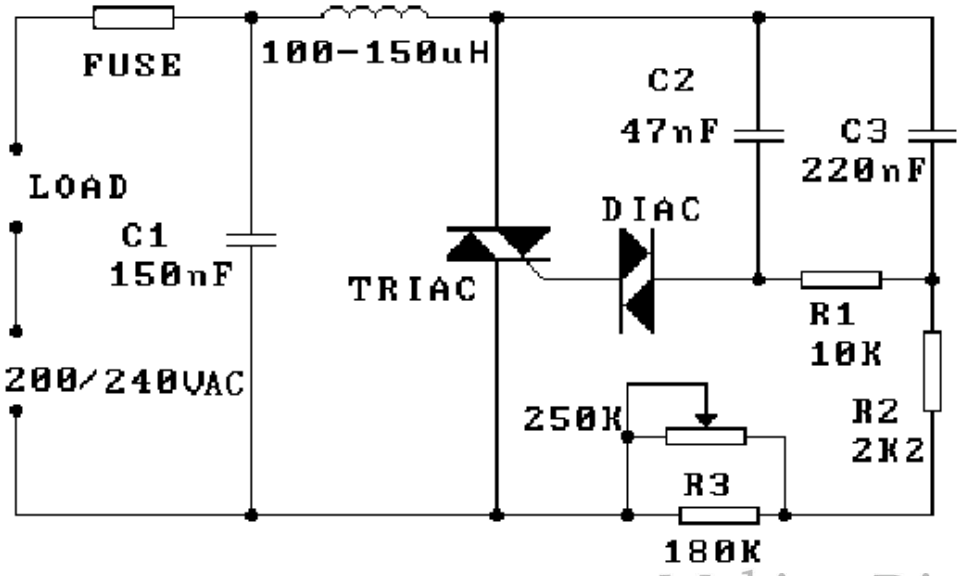
Man Made: Power Line Noise

- Power line noise often is caused by arcing across power line equipment. It declines in amplitude with frequency, and is typically more troublesome in rainy and windy conditions.

- Affects AM and FM but is most often noticed on AM as the recognizable buzz is demodulated in an AM receiver more readily than on FM. Power line noise is carried and radiated by the high tension lines compounding the problem.

Man Made: Light Dimmer Noise

Light dimmers made for home use incorporate thyristor devices which switch the AC line voltage with a very fast rise time. Unless effective filtering is used, these fast rise times can cause ringing which creates interference primarily in the AM band. Again, the AC power distribution serves as the antenna for the noise.



Man Made: Digital Circuitry

Huge advancements have been made in the speeds of computers, while at the same time there has been significant growth in the number of microprocessors in so many other devices in regular household use. Since these devices all include clocks ranging from a few kHz to hundreds of MHz, even when effective shielding and filtering are used, the cumulative effect of these devices raises the noise floor in the home, office, and automotive environment.

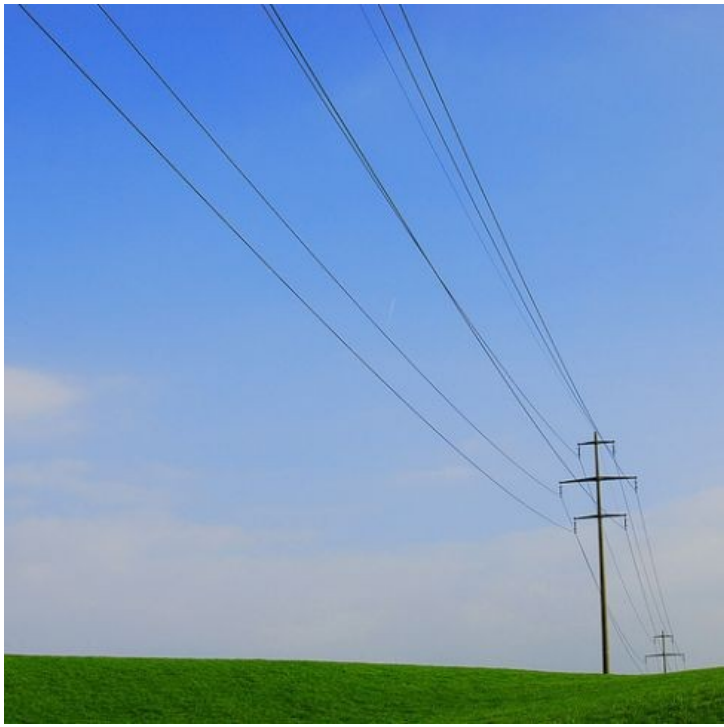
The noise generated by high speed logic has caused serious problems in AM and FM receiver design as the controllers used for the display as well as decoding of digital radio modes create signals which are picked up by the adjacent receiver front end circuitry, limiting the effective sensitivity of the receiver.

Man Made: Touch Control Lamps

In the past few years, inexpensive lamps for the home which may be switched on an off, or through a range of brightness levels, by touching a capacitive plate have become available. These lamps generally contain a free-running oscillator which changes frequency when the plate is touched. Unfortunately, these oscillators are also rich in harmonics and can radiate a wide range in frequency.

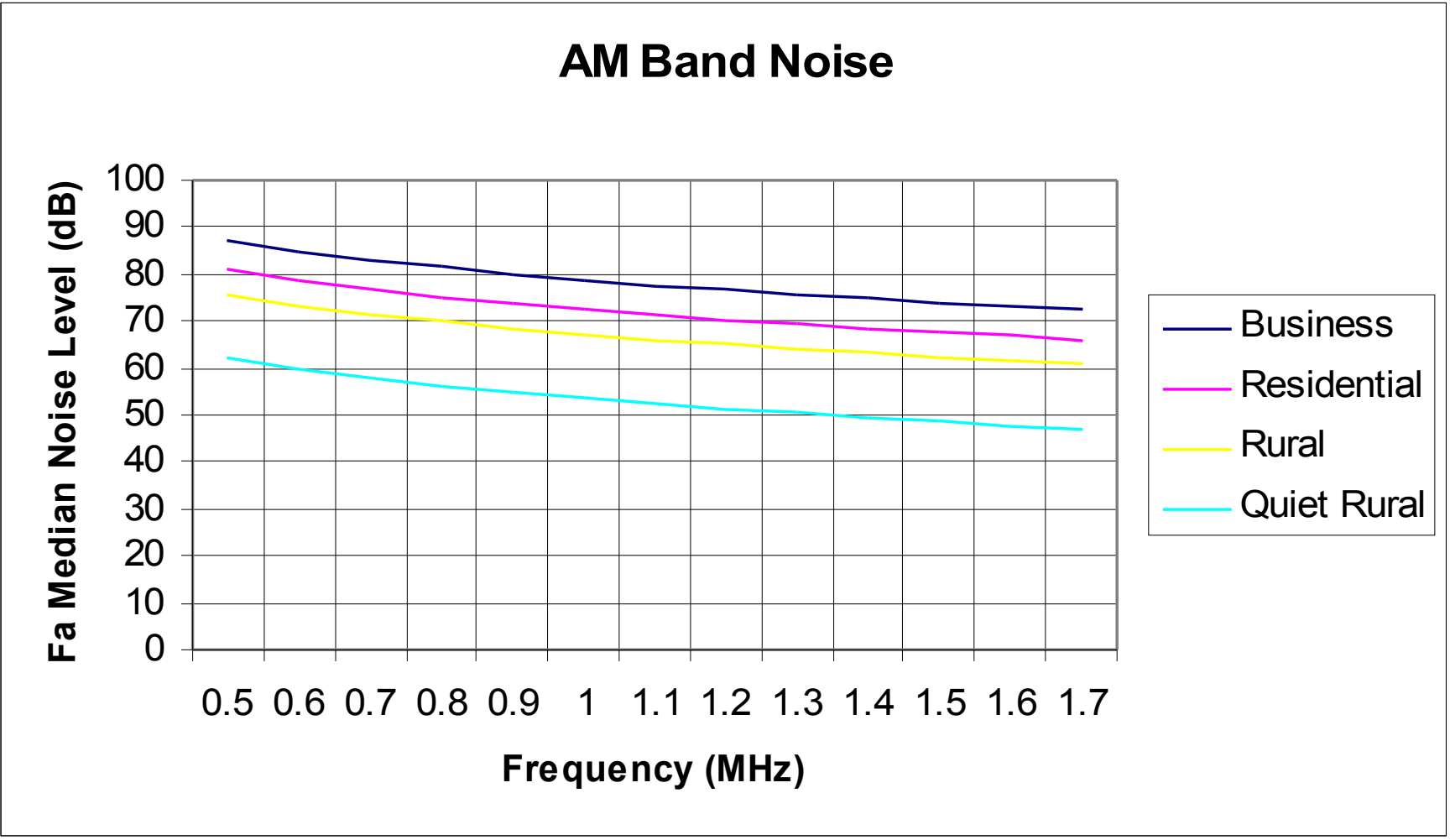
Man Made: Broadband over Power Line

In an effort to bring high speed internet access cost effectively to a wide geographic area, some power companies have implemented technology in which high frequency radio signals are carried on power lines.

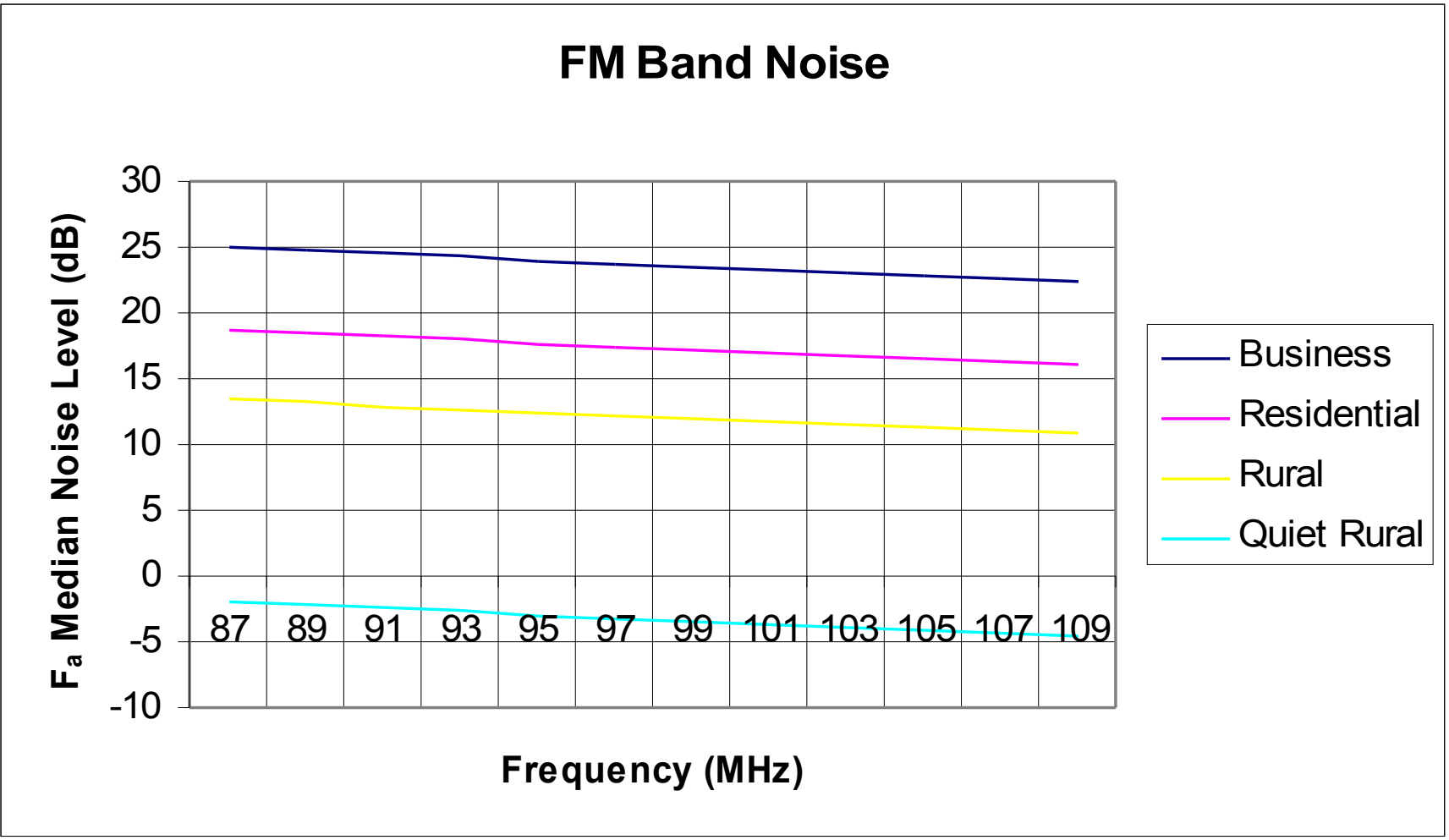


While US implementations of this have been limited to roughly 1.7MHz to 80MHz and would thus be limited to the spectrum between the AM and FM bands, internationally this is not always the case, and could be significant source of noise to radio broadcasters.

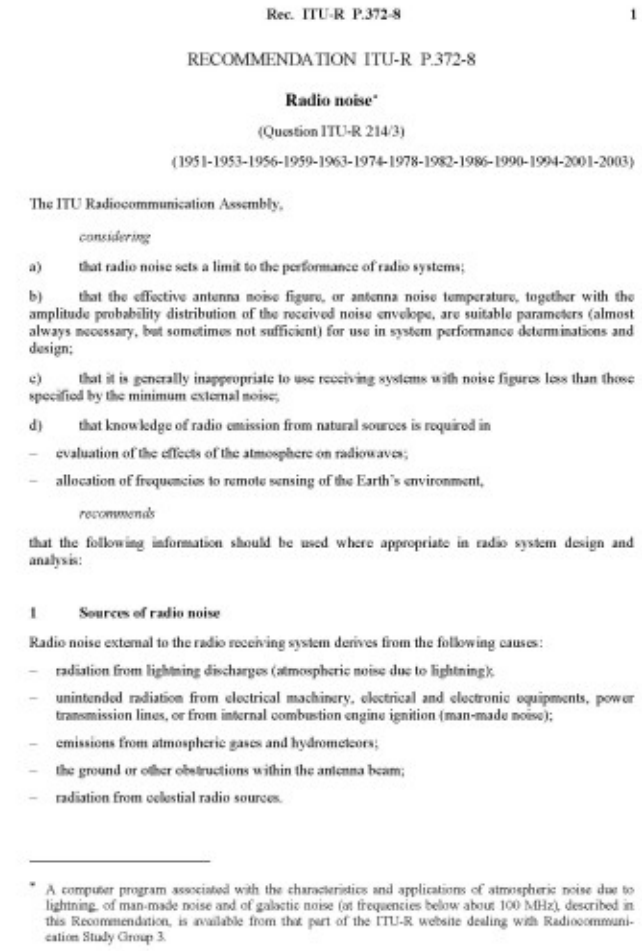
AM Band Noise by Location



FM Band Noise by Location



Studies on Noise Levels



Rec. ITU-R P.372-8 1

RECOMMENDATION ITU-R P.372-8

Radio noise*

(Question ITU-R 214/3)

(1951-1953-1956-1959-1963-1974-1978-1982-1986-1990-1994-2001-2003)

The ITU Radiocommunication Assembly,

considering

a) that radio noise sets a limit to the performance of radio systems;

b) that the effective antenna noise figure, or antenna noise temperature, together with the amplitude probability distribution of the received noise envelope, are suitable parameters (almost always necessary, but sometimes not sufficient) for use in system performance determinations and design;

c) that it is generally inappropriate to use receiving systems with noise figures less than those specified by the minimum external noise;

d) that knowledge of radio emission from natural sources is required in

– evaluation of the effects of the atmosphere on radiowaves;

– allocation of frequencies to remote sensing of the Earth's environment,

recommends

that the following information should be used where appropriate in radio system design and analysis:

1 Sources of radio noise

Radio noise external to the radio receiving system derives from the following causes:

– radiation from lightning discharges (atmospheric noise due to lightning);

– unintended radiation from electrical machinery, electrical and electronic equipments, power transmission lines, or from internal combustion engine ignition (man-made noise);

– emissions from atmospheric gases and hydrometeors;

– the ground or other obstructions within the antenna beam;

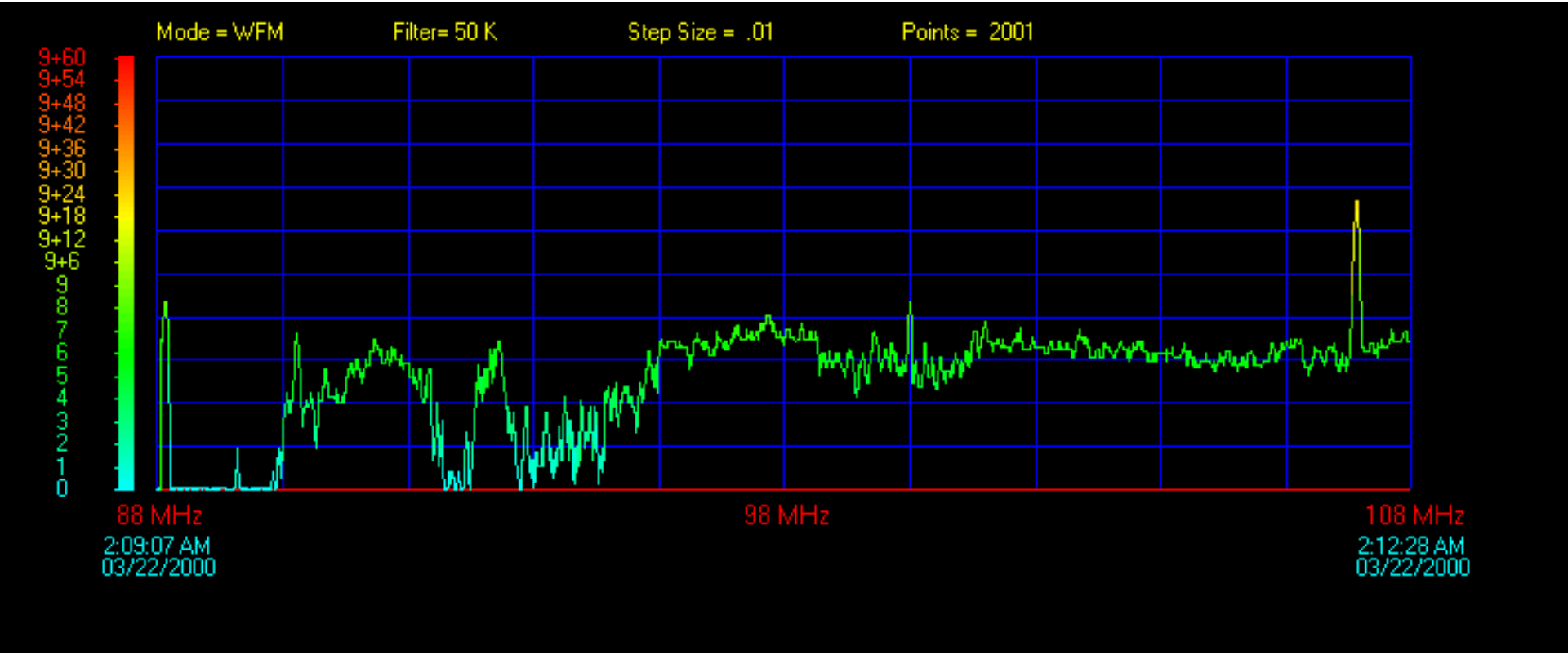
– radiation from celestial radio sources.

* A computer program associated with the characteristics and applications of atmospheric noise due to lightning, of man-made noise and of galactic noise (at frequencies below about 100 MHz), described in this Recommendation, is available from that part of the ITU-R website dealing with Radiocommunication Study Group 3.

- Many studies have been done over the last 30 years.
- Results have been mixed, with some concluding that average man-made noise levels have not changed.
- The studies do not focus on noise as seen within the Radio bands.
- Many broadcasters report anecdotally that they can no longer be heard in some areas due to noise and interference.

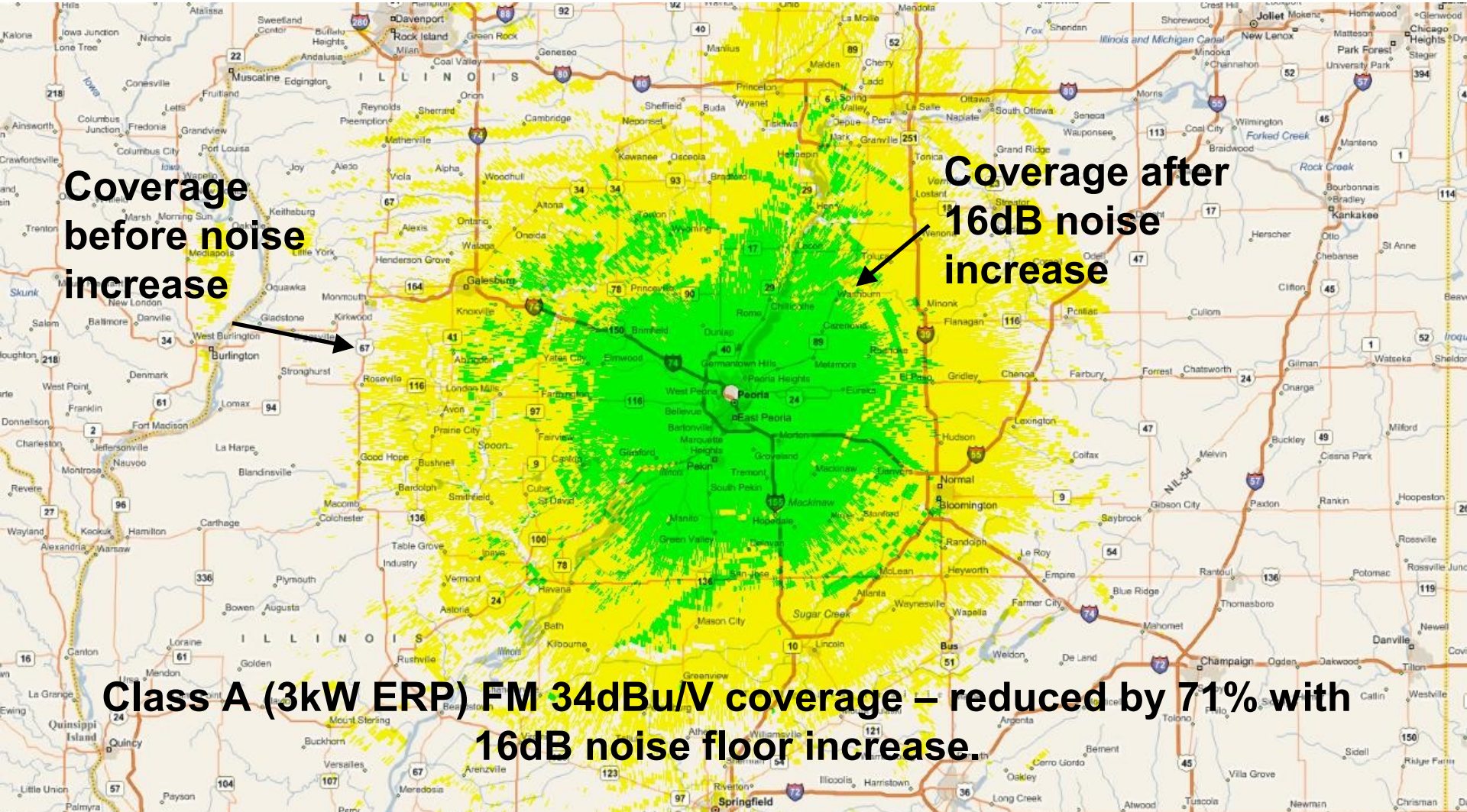
Band Measurements in India

In March of 2000, the author made some unscientific measurements of the AM & FM bands in Chennai, Delhi and Mumbai. These measurements were made before privatization.



Mumbai FM

The effect of increased noise levels on coverage



What can the broadcaster do ?

Radio broadcasters who are affected have a number of choices in dealing with the reduction in coverage, depending on local regulatory conditions:

- Consider changes to the transmitter location, power and antenna gain, height and directivity to provide higher signal strength over the areas most affected by increased noise.

- Investigate boosters on the same frequency to reach areas geographically separated or which have terrain shielding.

- Look into translators which can provide targeted coverage in key areas

Conclusion

The increase in urbanization, the proliferation of unintentional radiators of man made noise, and the increase of the number of AM and FM stations world wide is having an effect on the coverage areas of radio stations.

Those stations which went on the air 10 years ago or more who are in an increasingly urban area are at the greatest risk of experiencing a reduced coverage area.

Thank you.